CLAIMS :

1. A luminescent nanomaterial, said luminescent nanomaterial comprising a plurality of nanoparticles, wherein said plurality of nanoparticles comprises at least one lanthanide group metal phosphate and at least one lanthanide series dopant, wherein each of said plurality of nanoparticles has a predetermined morphology.

2. The luminescent nanomaterial according to Claim 1, wherein said luminescent nanomaterial has a quantum efficiency in a range from about 80% to about 100%.

3. The luminescent nanomaterial according to Claim 2, wherein said luminescent nanomaterial has a quantum efficiency in a range from about 80% to about 90%.

4. The luminescent nanomaterial according to Claim 2, wherein said luminescent nanomaterial has a quantum efficiency in a range from about 90% to about 100%.

5. The luminescent nanomaterial according to Claim 1, wherein said luminescent nanomaterial has a quantum efficiency of at least 100%.

6. The luminescent nanomaterial according to Claim 2, wherein said luminescent nanomaterial has an absorption value of at least 80%.

7. The luminescent nanomaterial according to Claim 1, wherein said lanthanide group metal phosphate comprises at least one of gadolinium phosphate and lanthanum phosphate.

8. The luminescent nanomaterial according to Claim 1, wherein said lanthanide group metal phosphate is one of lanthanum phosphate, gadolinium phosphate, gadolinium lanthanum phosphate, and combinations thereof.

9. The luminescent nanomaterial according to Claim 1, wherein said at least one lanthanide series dopant comprises at least one of cerium, terbium, and combinations thereof.

10. The luminescent nanomaterial according to Claim 1, wherein each of said plurality of nanoparticles has at least one dimension in a range from about 5 nm to about 500 nm.

11. The luminescent nanomaterial according to 10, wherein each of said plurality of nanoparticles has at least one dimension in a range from about 10 nm to about 200 nm.

12. The luminescent nanomaterial according to Claim 10, wherein each of said plurality of nanoparticles has at least one dimension in a range from about 50 nm to about 100 nm.

13. The luminescent nanomaterial according to Claim 1, wherein said predetermined morphology comprises at least one of a spheroidal morphology, an elongated platelet morphology, a rod-like morphology, and combinations thereof.

14. A luminescent nanomaterial, said luminescent nanomaterial comprising a plurality of nanoparticles, wherein said plurality of nanoparticles comprises at least one lanthanide group metal phosphate and at least one lanthanide series dopant, wherein each of said plurality of nanoparticles has a predetermined morphology, wherein said plurality of nanoparticles is formed by:

a) forming a homogenized precursor solution of at least one lanthanide group metal precursor and at least one lanthanide series dopant precursor;

b) adding a phosphate source and a fuel to said precursor solution;

c) removing water from said precursor solution to leave a reaction concentrate; and

d) igniting said reaction concentrate to form a powder comprising said luminescent nanomaterial.

15. The luminescent nanomaterial according to Claim 14, wherein said luminescent nanomaterial has a quantum efficiency in a range from about 80% to about 100%.

16. The luminescent nanomaterial according to Claim 15, wherein said luminescent nanomaterial has a quantum efficiency in a range from about 80% to about 90%.

17. The luminescent nanomaterial according to Claim 15, wherein said luminescent nanomaterial has a quantum efficiency in a range from about 90% to about 100%.

18. The luminescent nanomaterial according to Claim 14, wherein said luminescent nanomaterial has a quantum efficiency of at least 100%.

19. The luminescent nanomaterial according to Claim 15, wherein said luminescent nanomaterial has an absorption value of at least 80%.

20. The luminescent nanomaterial according to Claim 14, wherein said lanthanide group metal phosphate comprises at least one of gadolinium phosphate and lanthanum phosphate.

21. The luminescent nanomaterial according to Claim 14, wherein said lanthanide group metal phosphate is one of lanthanum phosphate, gadolinium phosphate, gadolinium lanthanum phosphate, and combinations thereof.

22. The luminescent nanomaterial according to Claim 14, wherein said at least one lanthanide series dopant comprises at least one of cerium, terbium, and combinations thereof.

23. The luminescent nanomaterial according to Claim 14, wherein each of said plurality of nanoparticles has at least one dimension in a range from about 5 nm to about 500 nm.

24. The luminescent nanomaterial according to 23, wherein each of said plurality of nanoparticles has at least one dimension in a range from about 10 nm to about 200 nm.

25. The luminescent nanomaterial according to Claim 23, wherein each of said plurality of nanoparticles has at least one dimension in a range from about 50 nm to about 100 nm.

26. The luminescent nanomaterial according to Claim 14, wherein said predetermined morphology comprises at least one of a spheroidal morphology, an elongated platelet morphology, a rod-like morphology, and combinations thereof.

27. A luminescent nanomaterial, wherein said luminescent nanomaterial has a quantum efficiency in a range from about 80% to about 100%, said luminescent nanomaterial comprising a plurality of nanoparticles, wherein said plurality of nanoparticles comprises at least one lanthanide group metal phosphate and at least one lanthanide series dopant, wherein each of said plurality of nanoparticles has a predetermined morphology, and wherein said plurality of nanoparticles is formed by:

a) forming a homogenized precursor solution of at least one lanthanide group metal precursor and at least one lanthanide series dopant precursor;

b) adding a phosphate source and a fuel to said precursor solution;

c) removing water from said precursor solution to leave a reaction concentrate; and

d) igniting said reaction concentrate to form a powder comprising said luminescent nanomaterial.

28. The luminescent nanomaterial according to Claim 27, wherein said luminescent nanomaterial has a quantum efficiency in a range from about 80% to about 90%.

29. The luminescent nanomaterial according to Claim 27, wherein said luminescent nanomaterial has a quantum efficiency in a range from about 90% to about 100%.

30. The luminescent nanomaterial according to Claim 27, wherein said luminescent nanomaterial has a quantum efficiency of at least 100%.

31. The luminescent nanomaterial according to Claim 27, wherein said luminescent nanomaterial has an absorption value of at least 80%.

32. The luminescent nanomaterial according to Claim 27, wherein said lanthanide group metal phosphate comprises at least one of gadolinium phosphate and lanthanum phosphate.

33. The luminescent nanomaterial according to Claim 27, wherein said lanthanide group metal phosphate is one of lanthanum phosphate, gadolinium phosphate, gadolinium lanthanum phosphate, and combinations thereof.

34. The luminescent nanomaterial according to Claim 27, wherein said at least one lanthanide series dopant comprises at least one of cerium, terbium, and combinations thereof.

35. The luminescent nanomaterial according to Claim 27, wherein each of said plurality of nanoparticles has at least one dimension in a range from about 5 nm to about 500 nm.

36. The luminescent nanomaterial according to Claim 35, wherein each of said plurality of nanoparticles has at least one dimension in a range from about 50 nm to about 100 nm.

37. The luminescent nanomaterial according to Claim 35, wherein each of said plurality of nanoparticles has at least one dimension in a range from about 50 nm to about 100 nm.

38. The luminescent nanomaterial according to Claim 27, wherein said predetermined morphology comprises at least one of a spheroidal morphology, an elongated platelet morphology, a rod-like morphology, and combinations thereof.

39. A method of making a luminescent nanomaterial comprising a plurality of nanoparticles, wherein said plurality of nanoparticles comprises at least one lanthanide group metal phosphate and at least one lanthanide series dopant, wherein said plurality of nanoparticles has a predetermined morphology, the method comprising the steps of:

a) providing at least one lanthanide group metal precursor and at least one lanthanide series dopant precursor;

b) forming a homogenized precursor solution comprising said at least one lanthanide group metal precursor and said at least one lanthanide series dopant precursor;

c) adding a phosphate source and a fuel to said homogenized precursor solution;

d) removing water from said homogenized precursor solution to leave a reaction concentrate; and

e) igniting said reaction concentrate to form a powder comprising said plurality of nanoparticles.

40. The method according to Claim 39, wherein each of said lanthanide group metal precursor and said lathanide series dopant precursor comprises at least one of an oxide, an acetate, and a carbonate precursor of a lanthanide group metal.

41. The method according to Claim 40, wherein the step of forming a homogenized precursor solution of at least one lanthanide metal group precursor comprises:

a) reacting the at least one lanthanide metal group precursor and the at least one lanthanide series dopant precursor with a nitrate source to form a lanthanide nitrate; and

b) dissolving the lanthanide nitrate in water.

42. The method according to Claim 41, wherein the nitrate source comprises at least one of nitric acid and ammonium nitrate.

43. The method according to Claim 39, wherein said lanthanide group metal precursor and said lanthanide series dopant precursor each comprise a nitrate precursor of a lanthanide group metal.

44. The method according to Claim 39, wherein said homogenized precursor solution is formed by dissolving said at least one lanthanide group metal precursors and said at least one lanthanide series dopant precursor in water.

45. The method according to Claim 39, wherein said homogenized precursor solution has a pH in a range from about 0.5 to about 5.

46. The method according to Claim 45, wherein said pH is in a range from about 1 to about 3.5.

47. The method according to Claim 39, wherein said phosphate source comprises at least one of di-ammonium hydrogen phosphate, phosphoric acid, and boron phosphate.

48. The method according to Claim 39, wherein said fuel is a carbon source.

49. The method according to Claim 48, wherein said carbon source is urea.

50. The method according to Claim 48, wherein said carbon source is glycine.

51. The method according to Claim 48, wherein said carbon source is hydrazine.

52. The method according to Claim 41, wherein said fuel and said lanthanide nitrate are present in said homogenized precursor solution, in a ratio in a range from about 1:2 to about 2:1.

53. The method according to Claim 39, wherein said homogenized precursor solution is ignited by a microwave oven.

54. The method according to Claim 39, wherein said homogenized precursor solution is ignited by a furnace.

55. The method according to Claim 39, wherein said homogenized precursor solution is ignited by a hot plate, heated to a predetermined temperature

56. The method according to Claim 54, wherein said predetermined temperature is in a range from about 200°C to about 500°C.

57. The method according to Claim 54, wherein said predetermined temperature of is in a range from about 200°C to about 300°C.

58. The method according to Claim 39, further comprising the step of homogenizing said powder.

59. The method according to Claim 39, further comprising the step of homogenizing said powder, wherein the step of homogenizing said powder comprises at least one of grinding and milling said powder.

60. The method according to Claim 39 further comprising the step of stabilizing said powder, wherein the step of stabilizing comprises heating said powder to a predetermined temperature in a controlled atmosphere for a period of time.

61. The method according to Claim 59, wherein said predetermined temperature is in a range from about 600°C to about 1200°C.

62. The method according to Claim 59, wherein said predetermined temperature is in a range from about 800°C to about 1000°C.

63. The heat treatment according to Claim 59, wherein said controlled atmosphere comprises at least one of air, nitrogen, hydrogen, and combinations thereof.

64. The heat treatment according to Claim 59, wherein said period of time is in a range from about 1 hour to 12 hours.

65. The heat treatment according to Claim 63, wherein said period of time is in a range from about 1 hour to 6 hours.